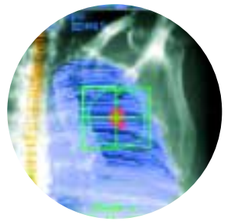
About the Battelle Memorial Institute

Battelle is recognized worldwide for technology development, management and commercialization, as well as the development of industry/government/academic partnerships. Battelle's 7,500 scientists, technologists and specialists conduct more than 4,500 projects each year. Clients include the *Fortune* 50 and federal, state and local governments as well as universities in the U.S. and overseas. Battelle's Technology Partnership Practice has assisted almost every state, numerous universities, and many regional and locally based technology organizations in the development of technology strategies, policies and programs, as well as in the evaluation of such efforts. Battelle prepared "State Government Initiatives in Biotechnology, 2001" for the Biotechnology Industry Organization (BIO). The report is the first comprehensive survey of state government efforts to attract and grow the biotechnology industry.



A Time for Action

life sciences

AN OPPORTUNITY TO BUILD MISSOURI'S ECONOMIC FUTURE

Prepared for:

The State of Missouri
The Danforth Foundation
The Ewing Marion Kauffman Foundation

Missouri Life Sciences Strategy Report Steering Committee

Travis Brown
Chairman, Missouri Biotechnology Association (MOBIO)

William Danforth
Chancellor Emeritus,
Washington University
Chairman, The Coalition for Plant and Life Sciences

Joseph L. Driskill
Director
Missouri Department of Economic Development

Richard C.D. Fleming
President and CEO
St. Louis Regional Chamber and Growth Association

Robert Koff
Senior Vice President
Danforth Foundation

Nikki Krawitz
Vice President, Finance and Administration
University of Missouri System

Stephen Lehmkuhle
Vice President of Academic Affairs
University of Missouri System

Robert Marcusse
President and CEO
Kansas City Area Development Council

Kurt Mueller
Senior Vice President
Ewing Marion Kauffman Foundation

Dennis Roedemeier
Director, Business Development Group
Missouri Department of Economic Development

Bill Romjue
Executive Director
Missouri Biotechnology Association (MOBIO)

Donn Rubin
Executive Director
The Coalition for Plant and Life Sciences

Jewel Scott
Executive Director
Civic Council of Greater Kansas City

James Spigarelli
President and Chief Executive Officer
Midwest Research Institute

Laura Winter
Program Associate
Danforth Foundation

0103

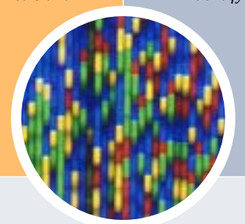
▲ *Missouri life sciences help farmers produce more food with less land, fewer chemicals and reduced input costs.*

BACKGROUND

In 2001, Missouri Governor Bob Holden, the Danforth Foundation and the Ewing Marion Kauffman Foundation commissioned the Battelle Memorial Institute to develop a Life Sciences Strategy to guide future public and private investment decisions in Missouri. A Steering Committee of representatives of business, government and higher education from across the state was established to guide and oversee the study.

Battelle's Technology Partnership Practice analyzed Missouri's life sciences research base, interviewed dozens of individuals knowledgeable about the life sciences sector in Missouri, and compared Missouri with a number of other states that either are or seek to become leaders in the life sciences. The resulting report examines Missouri's life sciences assets and resources, around which the state's industry base has emerged over many decades, and recommends strategies for building a successful future.

▼ *Researchers across the state "read" DNA with a laser, translate the DNA into base sequences and identify genes to improve human health.*



Scientific discoveries in Missouri help doctors determine the cause, effective treatments and prevention of disease—improving patient care. ▶

THE VISION FOR MISSOURI'S FUTURE

Missouri will be a leader in the life sciences, a rapidly growing field with tremendous economic development promise.

Strong existing assets provide the state a unique opportunity to excel in the emerging "age of biotechnology." In capitalizing on its opportunity, Missouri will be a state where:

- Strong universities and not-for-profit institutions across the state conduct groundbreaking research in agriculture and biomedicine, and attract substantial federal and private dollars from outside the state to support their work
- Discoveries with commercial potential are transformed into companies that retain the economic benefit of the science in Missouri
- State-of-the-art facilities and physical infrastructure are available for firms as they evolve from the earliest proof-of-concept stage, through incubation, into mature companies
- Venture capital financing is accessible to emerging life sciences companies so they can remain in Missouri as they expand
- Educational institutions train a qualified, professional workforce to fill continuously created high-paying jobs; individuals have the opportunity to pursue fulfilling careers in Missouri
- A competitive business climate encourages life sciences businesses to locate and expand in Missouri

▲ *Missouri's research facilities foster business spin-offs and the growth of existing life sciences companies. Pictured: Stowers Institute for Medical Research*

◀ *Ft. Leonard Wood's promising environmental technologies have transformed the post into an economic development catalyst attracting new businesses, dollars and well-trained employees.*

THE NEED FOR A MISSOURI LIFE SCIENCES STRATEGY

The life sciences represent a comparative advantage on which Missouri can build its future as a "knowledge state" in research capacity, economic development and a highly skilled workforce. With the appropriate infrastructure and support, Missouri can turn its strong foundation on basic science and R&D into successful companies providing high-paying jobs for Missourians across the state.

The timing is ideal for state government, private and not-for-profit institutions to come together and make life sciences a common agenda for success.

Missouri is in an economic race for the future. The state's capacity to compete in a knowledge economy will determine its ability to create wealth and well-paying jobs for current and future generations. Other states recognize this immediate opportunity and are implementing aggressive plans to support the growth of their own life sciences and related technology industries.

The State of Missouri is fortunate to possess strong assets in the life sciences that offer tremendous potential for the state's economy. The state can become a leader by continuing to build and sustain its strong research base.

It is crucial that economic benefits of technology transfer and commercialization remain in Missouri and do not relocate to other technology centers. Removing obstacles allows for the location and growth of new and specialized businesses based on life sciences technologies.

The timing for Missouri has never been better. Building on its existing assets will make Missouri a hub for a expanding industry. To realize the full potential of regional efforts will require a clearly focused, statewide plan and long-term collaboration among the public, private and government sectors.

The time for Missouri to take action is now. By making a commitment to life sciences now—not two years or five years from now—Missouri can succeed in the race with other states that already are aggressively investing in life sciences.

Environmental Technologies **Missouri's third core strength in life sciences is emerging as environmental technologies, ranging from environmental protection and homeland security to biological and chemical defense. Midwest Research Institute, Ft. Leonard Wood and Saint Louis University are Missouri leaders in this field.**

Life Sciences: A Definition

"Life Sciences" describes a major cluster of important and growing industries, increasingly contributing to successful state economies. Advances in new fields, including the mapping of the human and plant genomes, are opening up exciting new economic opportunities. The life sciences attract dedicated, well-trained professionals to work in state-of-the art academic, not-for-profit and company facilities to discover, test and commercialize critical new products to help people live better lives. For example:

- *Improving people's health and well-being through the discovery and testing of new treatments to prevent and cure diseases*
- *Improving agricultural products and techniques to produce food economically for a growing population while protecting the environment*
- *Producing important environmental technologies, such as new vaccines and methodologies to protect people in the face of potential threats, including bioterrorism*

MISSOURI'S UNIQUE POTENTIAL

*Missouri has demonstrated research strength in two areas: **human disease treatment** and **plant and agriculture-related sciences.** A third area, **environmental life sciences**, is emerging, involving environmental protection and homeland security.*

▼ *Scientists in St. Joseph test pharmaceutical products to prevent and cure human disease. Pictured: Phoenix Scientific, Inc.*

▲ *Missouri's research institutions allow the state to compete for a greater share of life sciences R&D funding. Pictured: Donald Danforth Plant Science Center*

ASSET Saint Louis University's Center for the Study of Bioterrorism and Emerging Infections, Ft. Leonard Wood and the Midwest Research Institute are positioned to play a national role in biological and chemical defense.

ASSET Many private sector and not-for-profit firms serve as life sciences anchors for Missouri, including ABC Laboratories, Aventis Pharmaceuticals, Bayer, Boehringer Ingelheim Vetmedica, Cerner, Express Scripts, Monsanto, Quintiles, Sigma Aldrich and Wyeth BioPharma.

ASSET Several Missouri communities have already initiated life sciences strategies, including St. Louis, Kansas City, St. Joseph, Cape Girardeau, Kirksville and Joplin. In its report, Battelle sought to make recommendations that connect these efforts into a comprehensive statewide strategy.

ASSET Missouri has a fast-growing and sizeable research base, with two world-class not-for-profit institutions and a major emphasis on life sciences research at several universities. The Stowers Institute for Medical Research and the Donald Danforth Plant Science Center help build Missouri's image as a unique life sciences leader.

ASSET In FY 2000, Missouri's universities received $367 million in NIH awards. As federal funding for life sciences R&D expands dramatically, Missouri has an opportunity to capture a significant share of the $20 billion NIH grants each year. Universities and research institutions with state-of-the-art research labs and high-quality researchers and faculty can compete successfully for NIH funding.

ASSET Along with growth in basic research, Missouri continues to advance its position in clinical and applied research, where discoveries are translated into new medical treatments, agricultural products, and environmental services and products. For example, Washington University in St. Louis is a national leader in patient-oriented research; the University of Missouri and its extensive farm system offers a test-bed facility for new advances in the plant sciences; and Ft. Leonard Wood is a major testing center for new environmental technologies.

ASSET Missouri is home to the national headquarters of the American Soybean Association and the National Corn Growers Association.

ASSET Missouri has great potential in medical devices and instruments, research and testing, and, in particular, drugs and pharmaceuticals. The food and nutrition industry is the strongest Missouri life sciences specialization, with primary industry strength in agricultural chemicals.

ASSET The Missouri Biotechnology Association (MOBIO) has emerged as an influential statewide and regional leader in promoting the life sciences, including education, research, government and emerging company support.

ASSET The Missouri Botanical Garden is known for its fundamental botanical research, horticultural display and education programs.

Missouri's Life Sciences Profile
Excluding Hospitals (2001)

- 889 establishments
- 41,635 employees
- Ranked 12th in research expenditures
- 7.6 percent employment decline, '95–'01
- 29.2 percent establishment increase, '95–'01
- 1.2 percent private sector employment

▲ *Missouri's research facilities foster business spin-offs and the growth of existing life sciences companies. Pictured: Stowers Institute for Medical Research*

◀ *Ft. Leonard Wood's promising environmental technologies have transformed the post into an economic development catalyst attracting new businesses, dollars and well-trained employees.*

THE NEED FOR A MISSOURI LIFE SCIENCES STRATEGY

The life sciences represent a comparative advantage on which Missouri can build its future as a "knowledge state" in research capacity, economic development and a highly skilled workforce. With the appropriate infrastructure and support, Missouri can turn its strong foundation on basic science and R&D into successful companies providing high-paying jobs for Missourians across the state.

The timing is ideal for state government, private and not-for-profit institutions to come together and make life sciences a common agenda for success.

Missouri is in an economic race for the future. The state's capacity to compete in a knowledge economy will determine its ability to create wealth and well-paying jobs for current and future generations. Other states recognize this immediate opportunity and are implementing aggressive plans to support the growth of their own life sciences and related technology industries.

The State of Missouri is fortunate to possess strong assets in the life sciences that offer tremendous potential for the state's economy. The state can become a leader by continuing to build and sustain its strong research base.

It is crucial that economic benefits of technology transfer and commercialization remain in Missouri and do not relocate to other technology centers. Removing obstacles allows for the location and growth of new and specialized businesses based on life sciences technologies.

The timing for Missouri has never been better. Building on its existing assets will make Missouri a hub for a expanding industry. To realize the full potential of regional efforts will require a clearly focused, statewide plan and long-term collaboration among the public, private and government sectors.

The time for Missouri to take action is now. By making a commitment to life sciences now—not two years or five years from now—Missouri can succeed in the race with other states that already are aggressively investing in life sciences.

Human Disease Treatment **Developing therapies in areas such as cancer, cardiovascular diseases, infectious diseases, neurological and psychiatric disorders and geriatrics have tremendous potential for Missouri. Washington University, the University of Missouri and the Stowers Institute for Medical Research are assets upon which to build.**

Plant and Agriculture-Related Sciences **Missouri's scientific strengths include crop enhancements, improved nutrition, industrial applications and animal sciences. The University of Missouri, the Donald Danforth Plant Science Center, and a veterinary science concentration in Northwest Missouri represent a unique combination of assets.**

Environmental Technologies **Missouri's third core strength in life sciences is emerging as environmental technologies, ranging from environmental protection and homeland security to biological and chemical defense. Midwest Research Institute, Ft. Leonard Wood and Saint Louis University are Missouri leaders in this field.**

Other States' Investments in the Life Sciences

More than 40 other states are looking at ways to enhance their life sciences base, focusing on a broad range of diversified industrial activities. Even in these difficult budget times, many states are giving priority commitments to long-term investments in the life sciences in recognition of the far-reaching impact such actions will have on their future economy.

For example:

MARYLAND Two Maryland Technology Development Corporation programs forging partnerships between companies/universities and between companies/federal laboratories; post-secondary training support, resulting in the new "Biotechnical Institute of Maryland"

MICHIGAN $50 million/year for 20 years in "Life Sciences Corridor"

NORTH CAROLINA North Carolina Biotechnology Center Collaborative Funding Assistance Grants to faculty, encouraging university/industry partnerships and business loans; nonprofit Council for Entrepreneurial Development created at Research Triangle

OHIO $1.6 billion in "Third Frontier," including $250 million in Biomedical Research and Technology Transfer Fund; statewide biotechnology center with offices in four metro regions through Thomas Edison Program

OKLAHOMA Vigorous program of commercialization assistance centers, linked to a public source of seed-stage financing

PENNSYLVANIA $60 million annually for basic research; more than $160 million in one-time funds for bioscience-related venture funds; three "Life Sciences Greenhouses"

WISCONSIN "BioStar," a $317 million, 10-year research initiative; Wisconsin Investment Board created with $50 million in pension funds

Life Sciences: A Definition

"Life Sciences" describes a major cluster of important and growing industries, increasingly contributing to successful state economies. Advances in new fields, including the mapping of the human and plant genomes, are opening up exciting new economic opportunities. The life sciences attract dedicated, well-trained professionals to work in state-of-the art academic, not-for-profit and company facilities to discover, test and commercialize critical new products to help people live better lives. For example:

- *Improving people's health and well-being through the discovery and testing of new treatments to prevent and cure diseases*
- *Improving agricultural products and techniques to produce food economically for a growing population while protecting the environment*
- *Producing important environmental technologies, such as new vaccines and methodologies to protect people in the face of potential threats, including bioterrorism*

At Missouri's state-of-the-art academic institutions, researchers unravel the genomic maps of food and fiber and develop pharmaceutical drugs to treat diseases. Pictured: University of Missouri-Columbia Life Sciences Center

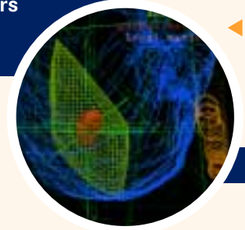
THE STRATEGY

With a strong statewide commitment to a comprehensive, multi-year strategy, Missouri can excel in the high growth area of life sciences, accruing benefits to rural and urban areas alike. Three critical, interrelated efforts comprise the strategy:

BUILDING RESEARCH CAPACITY—Enhancing the capacity of the state's universities and non-profit research institutions to undertake top-notch research—including facilities and personnel—pays enormous dividends and underpins the other two components of the strategy.

Missouri will reap dramatic returns on its investments by attracting additional federal and private research dollars, bringing in contracts from sources outside the state, attracting the best individuals and companies, and creating sustained economic and job growth. Dollars, people and business flow to those states with the greatest research capacity.

Leveraging Dollars from Outside of Missouri



Increased research capacity strengthens the ability to compete successfully for research grants and contracts from sources outside the state. **These external funds are plentiful:**

- **National Institutes for Health (NIH)** allocates over $20 billion annually
- **National Science Foundation (NSF)** allocates approximately $4 billion annually
- **Private agencies** such as the American Heart Association and the National Cancer Society provide hundreds of millions of dollars in research grants
- **U.S. and international industry** also provides extensive support for research

Life sciences research helps medical professionals better understand the origins of cancer to develop new diagnostic tools and therapies.

What is "research capacity"?

Capacity-building includes investment in **physical infrastructure**, such as facilities and laboratory improvements, equipment and instrumentation; and **human resources**, such as recruitment of individuals who bring new dimensions to Missouri's research capabilities.

For example, certain sophisticated equipment is a prerequisite to conduct specific types of genomic research considered a priority by federal funding agencies. Access to such equipment will open up large pools of otherwise unattainable funding to Missouri's research institutions.

Critical Investments Required Along the Life Sciences Continuum

BASIC RESEARCH

Sustained state investment in
- Research facilities
- Endowed chairs
- Collaborative research

Resources to advance promising research discoveries

TECHNOLOGY DEVELOPMENT

Strong university system for business interface and relationship building

Applied research oriented toward commercialization

FORMATION OF BIO COMPANIES

Available sources of pre-seed, seed and early-stage capital

Excellent, plentiful incubator and accelerator facilities

Strong infrastructure for providing business assistance to emerging life sciences companies

EXPANSION/ ATTRACTION

Coordinated statewide image/ marketing effort

Available multi-tenant facilities, leasehold upgrades and dedicated research parks for the life sciences

Focused, long-term efforts to develop a life sciences workforce

Missouri's life sciences companies create high-paying jobs and attract a skilled workforce. Pictured: Wyeth BioPharma

Plant sciences increase yields with fewer pesticides and herbicides and accelerate the development of value-added crops.

Needs for Growing a Life Sciences Company

To build a thriving life sciences industry, Missouri must have available a continuum of both **capital** and **facilities** to match the needs of a typical company as it matures.

Venture Capital Financing

COMPANY STAGE	PRIVATE INVESTMENT PER COMPANY
• Proof of Concept	$25,000 – $250,000
• Pre-Seed	$50,000 – $500,000
• Seed	$200,000 – $2 million
• Early-Stage	$1 million – $5 million
• Expansion-Stage	Up to $10 million
• Mezzanine or Pre-IPO	Up to $20 million

Facilities

FACILITIES/STAGE OF DEVELOPMENT	SQUARE FOOTAGE PER USER
• Pre-Incubator/ "Translation" Space	500 – 1,500
• Incubator Space	500 - 5,000
• Post-Incubator/ "Accelerator" Space	3,000 – 15,000
• Multi-Tenant Space	5,000 – 50,000
• Full-Scale Manufacturing Space	35,000 and up

CREATING ECONOMIC DEVELOPMENT—Research findings in the laboratory create opportunities for a critical mass of life sciences companies to bring these discoveries to market. A thriving life sciences hub puts together innovative ideas with the capital, facilities such as business incubators and research parks, and other necessary elements to create an environment to nurture new companies, attract mature ones and create high-wage jobs.

Establishing strong links between universities and industry is critical to advancing life sciences industry development. Developing investment capital and commercial life sciences facilities will help attract, grow, and retain life sciences companies and the excellent jobs they represent, benefiting entire individual communities and the state as a whole.

DEVELOPING A SKILLED WORKFORCE—Encouraging students and workers to pursue training and careers in the life sciences, and ensuring educational institutions in the state emphasize the necessary curricula for success, will create growth opportunities for Missouri. States with a steady supply of educated, highly skilled employees have a major competitive advantage in developing, attracting and growing their economies.

Entrepreneurs create new companies as a result of strong research capacity and locate near research strengths they deem important to their success. Scientist/ entrepreneurs and the companies they create provide the engine for creating jobs in the exploding life sciences industry.

MISSOURI'S LIFE SCIENCES OPPORTUNITY IS NOW

The State of Missouri's strong assets in the life sciences offer tremendous potential for the state's economy. Communities across Missouri already have developed and begun implementing life sciences strategies Missouri can leverage in its broader statewide strategy.

Choosing to establish Missouri as a leader in the life sciences takes advantage of an opportunity to diversify the state's economy, leverage its research assets, attract significant federal and industrial investments to the state, improve the skilled workforce, and increase disposable income and wealth for businesses and individual citizens.

When Governor Holden and the Danforth and Ewing Marion Kauffman Foundations named a Steering Committee and commissioned Battelle to create a life sciences strategy for Missouri, they set in motion a series of important events. To move the process forward, these leaders hope Missourians and their leaders will make the commitment to read the full report, digest its analysis and recommendations, and carefully consider its implications for the future.

The Battelle report presents multi-year recommendations for Missouri that will require long-term discussion and a thoughtful, collaborative process among the state's citizens, government representatives, business leaders, economic developers, and many others. Missourians have the chance now to become aware of the unique opportunity, educate themselves, understand the need for an action plan, and become personally involved in achieving the full promise the life sciences represent for this uniquely positioned state.

▲ *Plant sciences help crops resist pests and disease, eliminating some chemical applications.*

▲ *Emerging technologies from new life sciences companies in Missouri reduce patient risk and invasive procedures. Pictured: Stereotaxis, Inc.*

For a copy of the full report:

Life Sciences & Missouri's Economic Future: An Opportunity to Build "One Missouri"

Prepared by:
Technology Partnership Practice
Battelle Memorial Institute
Cleveland, Ohio

Please visit:
www.gov.state.mo.us

Or contact:
Laura Winter
The Danforth Foundation
One Metropolitan Square
211 N. Broadway, Suite 2390
St. Louis, MO 63102
(314) 588-1900
lwinter@danforthfoundation.org